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ABSTRACT

Much of the research on classroom use of educational media has been hampered by difficulties in isolating a single element of the medium--television programming, for instance--that influences behavior in a reliable way. Still, each medium facilitates a particular type of learning environment, and the collective characteristics of those environments must be examined for possible effects. The learner in the television-based learning environment is often passive, and some experts would suggest that such learners exhibit learned helplessness. This refers to behavior observed in situations where a person's actions have no effect on outcomes. This report describes a study which updates the author's previous work in this area. The study tries to replicate an earlier finding that 15 minutes of a mediated learning experience, like a math video, would more often lead to less persistence or propensity for challenge, than a more active learning environment would. The study focused on 90 second- and third-graders in four classroom from three different schools. Students in two of the classrooms were from a small city in upstate New York. One of these classes was bilingual. Two of the classrooms were from suburban New York. Using tangram puzzles of varying difficulty, the researcher found that students who viewed a video gave up on hard puzzles and opted for easier ones sooner than students who has previously been engaged in more active treatments of the same topic. Five figures and three tables illustrate the results. (Contains 25 references.) (BEW)

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Unintended Results of Using Instructional Media: A Study of Second- and Third-Graders

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AERA, April, 1996

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Unintended Results of Using Instructional Media:
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Background

Media Effects

Educational media are used in the classroom with increasing frequency. However research into the effects of the medium-based learning environment has been sparse. Perhaps because of the relative youth of the rest of the educational media, most research into this area has focused on television, with mixed results. It has been difficult to isolate a single element of television programming that affects behavior in a reliable way. Clark (Clark, 1983) has argued articulately that when a medium-based learning experience and a non-medium-based learning experience are made equivalent in every factor save the one under consideration that any apparent medium effect disappears. That is, a learning environment in which Professor Smith lectures on the physiology of fetal rat development produces the same learning effects whether the professor is lecturing in person or on video tape, all else being equal. While this may be the case, and certainly many television studies support this type of claim (Anderson, Levin & Lorch, 1977; Tower, Singer, Singer & Biggs, 1979, and others) it is also true, as (Kozma, 1991) points out, that each medium facilitates a particular type of learning environment and these learning environments must be examined carefully for effects. Thus, while no single aspect of the educational television program may affect learning, taken together the factors that contribute to the educational television program learning environment may have profound effects that should not be ignored.

The most salient characteristic of the television learning environment is the passivity of the learner. Anderson has pointed out (Anderson & Collins, 1988) that researchers must define passivity very carefully when discussing television viewing since it is not at all clear in what ways television viewing is a passive activity. So in these studies a passive learning environment is defined as one in which the learners are able to watch but not interact with the objects and events from which they are learning. Thus, body motion, cognitive activity and attention are not of concern here. This definition is similar, in its

focus on interaction rather than body motion, to several from animal learning paradigms, such as Diamond's impoverished rat condition which consists of a rat, alone, able to watch other rats involved in stimulating interactions but unable to interact itself (Diamond, 1990), or Held's yoked cat paradigm in which a cat is able to view and perceive but not interact with the stimulating environment that another cat is interacting with (Held, 1965). It is also quite similar to the conditions necessary for producing learned helplessness.

Learned Helplessness

Learned helplessness refers to the debilitated behavior exhibited by people and animals following uncontrollable circumstances, such as uncontrollable loud noise, or an experience in which outcomes are not contingent on the learner's actions. Learned helplessness research began with animals, but recently learned helplessness research in humans has rejected the animal data as insufficient to describe the varied responses people make in non-contingent situations. For example, Abramson and her colleagues (Abramson, Seligman & Teasdale, 1978) reformulated the learned helplessness framework to include attributions people make that helped to explain different reactions to similar circumstances. Dweck and her colleagues ((Diener & Dweck, 1978; Dweck & Leggett, 1988; Elliott & Dweck, 1988)) have studied the learned helplessness pattern and have found that it seems to depend on the type of goals and beliefs the child has. That is, children have general goals and beliefs and these correlate with the learned helplessness pattern. But these beliefs and goals can also be manipulated experimentally to produce the pattern, regardless of original goals and beliefs. Learned helplessness in people seems to be quite affected by goals, beliefs and attributions.

While goals, beliefs and attributions seem to be sufficient, they are not necessary for producing learned helplessness. For example, Fox and Oakes (Fox & Oakes, 1984) had subjects play one of two versions of a video game. In one version targets on the video screen were hit when the player aimed and pressed the game button accurately. In the other version targets were hit at random, regardless of when the button was pushed. This non-contingent version was constructed so as to give the player the impression that the "hits" followed from the player's actions. Fox and Oakes found that both the contingent and non-contingent players believed the "hits" to be

contingent on their actions, even though the hits were in fact only contingent on the actions of the "contingent" group. Following this video game experience members of the contingent group performed significantly better on a lexical decision task than did the members of the non-contingent group. Notice that both groups are achieving some amount of apparent success and both groups believe that they are controlling the outcome. The only difference is that one group is having an experience in which their success is not contingent on their actions. Thus, attributions cannot be necessary to produce this effect, nor can feelings of dejection or low self-esteem.

Learned Helplessness and Educational Television

It seems reasonable to expect that something like this holds true for the television learning experience as well, since inherent in the experience is a dissociation between what the viewer does and the stimulation or feedback the viewer receives (see (Hearn, 1991) for an articulate argument along these lines) thus defining a non-contingent experience. Television, regardless of its content or programming, sets up a context in which the feedback, stimulation, and rewards that accrue to the viewer are not contingent on what the viewer does, beyond turning the television set on or off, or turning to a different channel (See (Flanagan, 1994) for a more complete theoretical discussion). Because of this dissociation between action and experience television viewing provides an environment in which a learned helplessness pattern can emerge.

Pilot study

In a prior study Flanagan and Black (Flanagan & Black, 1993) focused on the effect on persistence of various passive learning experiences. They hypothesized that children would exhibit signs of a learned helplessness effect following an educational video. Specifically, they expected to find that children would choose more challenging math problems to work on following actively involved math learning than they would following the watching of a math video. They also hypothesized that children would exhibit overall helpless tendencies based on the amount of television they watch in general.

To test these hypotheses they worked with 61 third graders from three classrooms over four sessions per classroom. At each session the students spent 15 minutes watching

one of two math videos, working on math puzzles, or listening to a math story. Each class got all four sessions in a different order. Following this activity the students worked on measurement problems. Each problem was either clearly very easy or clearly very hard. Following these problems the students were given the choice of whether to continue working on hard problems or easy ones. Persistence was measured, in this study, as the number of clearly marked hard problems the student chose to work on. A within subjects design was used so that most differences between session types could be attributed to the type of session itself and not differences between students.

They found that following the active puzzle-solving session students showed significantly greater persistence than following the sessions that began with watching a video or listening to a story ($p<.001$). Specifically the mean persistence for the puzzle session was 1.72 compared to 1.08 and .97 for the video sessions and .51 for the story session.

They also attempted to determine how much television they watched at home. This is a notoriously difficult measurement to make (Miller, 1986), especially with young children. They tried two different methods, neither of which correlated significantly with the persistence measure. This may be due to the wide range of reading ability among these students and the heavy reliance of this measurement on reading ability.

This study suggested that the passive learning experience characteristic of television viewing may indeed have a profound impact on persistence even after only 15 minutes of viewing.

In this second study I tried to replicate the finding that 15 minutes of a mediated learning experience would lead to less persistence on hard problems than 15 minutes of something more active. I used more balanced treatments: two video sessions, two non-video sessions; one of each type of session for each of two topics: scale modeling and doing mental math. I used a persistence measure that was less susceptible to differences in literacy. I eliminated the home viewing questionnaire and focused instead only on in-class behavior, and I simplified greatly questions regarding the students' attitudes toward the four treatments. I retained the within-subjects design.

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Hypothesis

Specifically I tested the hypothesis that following as little as 15 minutes of educational television viewing students would be less persistent in working on hard math puzzles than they would be following 15 minutes of an activity on the same topic.

Method

Participants

I worked with 90 second- and third-graders in four classrooms from three different schools. The students in two of the classrooms were from low- to moderate SES, from a "rural urban" environment, that is, a small city in upstate New York. One of these classrooms was bilingual. Two of the classrooms were from moderate- to high SES, from suburban New York. Students who missed one of the four sessions were eliminated from the study leaving 77 students: 40 girls and 37 boys, mean age 8.36 years old. Of these remaining students 12 were African-American, 16 were Hispanic, and 49 were white.

Procedure

I met with each classroom five times for 40 minutes at each of the five sessions. The first session was an introductory session to accustom the students to the work we'd be doing together. At this session no data were collected. Sessions two through five all began with 15 minutes of either an educational video, on one of two topics, or with 15 minutes of a non-mediated activity, on one of the same two topics. Thus, each classroom participated in a 2 x 2 matrix of sessions: video or non-mediated activity as one dimension of the matrix and subject matter as the other dimension. The sessions were counterbalanced as to medium and subject matter so that each classroom participated in all four sessions in a different order to balance out practice and exposure effects.

The "treatments", or initial activities, consisted of two fifteen minute math videos produced by "Mathworks" for PBS. One was on scale modeling. It included a story line,

some animation, some humor, some field trips, children from several ethnic groups, people of many ages, and several motivational messages such as "young geniuses should not be afraid to try something hard!" This was in addition to the primary content which was using scale ratios to create scale models and to reason about scale and ratios. The other was on doing mental addition of two-digit numbers. It included a story line, some animation, some humor, children from several ethnic groups, media satire, and some motivational messages such as "he didn't get this fast at mental arithmetic overnight: it took hours of practice!". This was in addition to the primary content which was two carefully described methods for doing, and practicing, mental arithmetic.

The other two "treatments" were non-medium-based activities involving the same two math topics: scale modeling and mental arithmetic. For the scale model activity the children spent fifteen minutes producing a scale model of a book or notebook from their desk. They used graph paper, ruler, pencil, scissors, and tape. They were told that for every inch they measured they should make the model one quarter-inch, or one square on this particular graph paper. If they finished a model they either made the model more detailed or else they modeled another book or notebook. Not everyone was able to finish a model within the 15 minutes. Finally, the mental arithmetic activity involved learning a simple 3-step technique for doing mental arithmetic of double-digit numbers. I presented the technique and members of the class each took a turn doing at least one step of the 3-step process. Following this I directed a "mental math journey" in which the students were directed to think of a particular number, add a number to it, add another number to it, subtract a number, et cetera.

Following each of the 15-minute treatments the students were given a persistence test which is described in the section labeled "persistence task".

Following the initial activity (either video or non-medium-based activity)(15 minutes) and the persistence task (see next subsection)(10 minutes) the students answered two questions on a questionnaire. The purpose of the questionnaire was to determine roughly whether or not attitude toward the treatment had an effect on the dependent measure. The questionnaire was designed to require little or no reading, was printed in large type with a graphic scale dominating the page, as follows.

The activity we started with today was

Very fun |_____|_____|_____| **Very boring**

Very hard |_____|_____|_____| **Very easy**

The students were read the two questions each time and were told to make a mark on the line that was either near, for example, "very fun" or "very boring" or somewhere in between. They were told that there were no right or wrong answers; I just wanted to know what they really thought about these activities. The questionnaire responses were scored on a scale of one to seven, one being "very fun" or "very hard" and seven being "very boring" or "very easy" depending on where the student made a mark. In a few instances students placed two marks on the same response scale. In these cases the score was the average of the two marks.

The persistence task

I chose a persistence task that would not reflect literacy skills nor acquisition in a particular domain. I wanted an activity that every student could participate in, but I also wanted a very difficult problem so that I could look at persistence in a tough situation. For these reasons, I chose to use tangram puzzle solving persistence as the dependent measure which is similar to some other persistence tests in the literature (Banta, 1970; Rholes, Blackwell, Jordan & Walters, 1980).

The tangram puzzle is an ancient Chinese puzzle using 7 geometric pieces cut from a single square (see Figure 1). From these 7 pieces many figures can be made. A puzzle consists of the silhouette of all 7 pieces combined in some way such that all 7 pieces are used and none overlap with each other. A hard puzzle is one in which there are few constraints on where each piece may go but only one combination that works for all pieces (see Figure 2 for example). An easy puzzle is one in which the position of one or more pieces is constrained by a unique silhouette (see Figure 3).

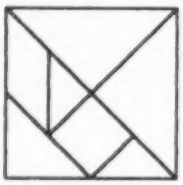


Figure 1: Tangram Puzzle, 7 Pieces from a Square Tile

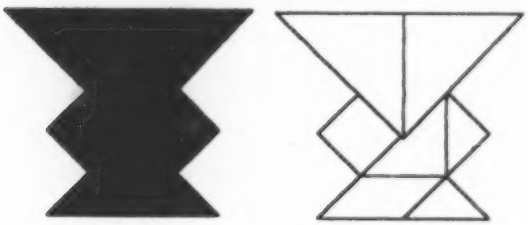


Figure 2: a Hard Tangram Puzzle and its Solution

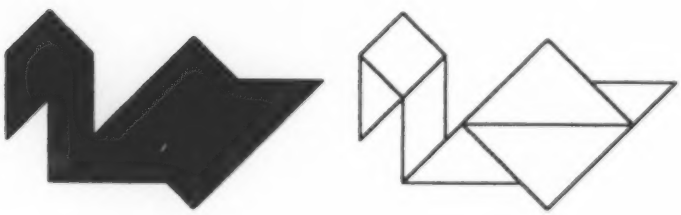


Figure 3: an Easy Tangram Puzzle and its Solution

I chose difficult puzzles, as described above, and measured the length of time before the student requested an easier puzzle to work on. I was not concerned so much with successful solution as I was with how long the student stayed with these obviously difficult, but do-able, puzzles. At each session, each student was given one of nine different puzzles to work on. No student was given the same puzzle twice and puzzles were assigned randomly, excluding puzzles previously worked on.

After the first, introductory, session during which a brief history of the puzzle and some general puzzle solving guidelines were given, the students were given the same instructions at each session:

- These tangram puzzles are very difficult.
- There is no trick to them: just keep trying different combinations.
- Please work on these by yourselves: do not work in groups; do not help one another.
- If you feel you need to switch to a different puzzle, please do NOT switch with a friend or neighbor: come to me.

Students seemed to enjoy working on the puzzles and did not seem to be confused about how to work the puzzles.

The students were given ten minutes at each session to work on these puzzles. If a student wanted to switch to an easier puzzle they were reminded that there was no trick to the puzzle, it was just a matter of trying a lot of different combinations. If they still wished to switch they were given an easier puzzle in exchange for the difficult puzzle and a note was made of how many minutes they had worked on the difficult puzzle. Their persistence score was the number of minutes they had worked on the difficult puzzle. Students who worked on the difficult puzzle for the full ten minutes were given a persistence score of ten minutes. If a student solved a puzzle they were given one of the puzzles from the introductory session to work on until the ten minutes were over. Since the student had persisted until solution of the puzzle the student was marked as a persister and given a persistence score of 10 minutes even though the actual time to solution was often shorter. Overall, 21.5% of the difficult puzzles were solved and 78.4% of the difficult puzzles were unsolved. This higher-than-expected solution rate was due primarily to three puzzles which looked difficult but proved to be fairly solvable (35.5% were solved). Without these three, which will not be used in future studies, the solution rate was 15.5%.

I used this as my operational definition of persistence in a difficult, contextual task. While it is certainly not a complete measure of persistence it suffices for the purposes of this within-subjects study. It measures some aspect of persistent behavior within an individual student in a consistent manner across four different treatments. Thus we may attribute any differences to differences in treatment.

Debriefing

During the last session, while the students were still working on the tangram puzzles, the teachers were asked to make attributions regarding their students' performance on the tangram task as well as any suggestions they had for future research endeavors. The purpose of this questionnaire was to get an initial indication of whether teacher attitudes toward achievement might be influencing persistent behavior and also to give the teachers a chance to give me feedback. No trends relating teacher attitude to tangram achievement were apparent from the questionnaire, but this question remains open. Finally, at the end of the last session the students were told about the study and why I had them working on such hard tangrams.

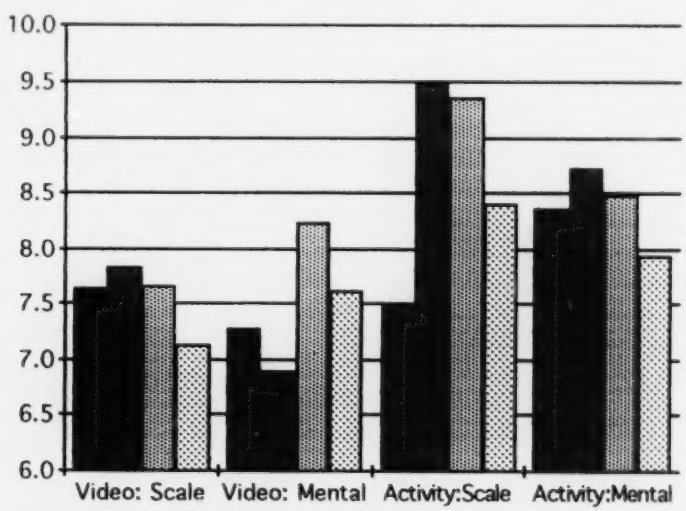
Results

The data supported the hypothesis that following as little as 15 minutes of television viewing students would be less persistent in working on hard math puzzles than they would be following 15 minutes of an activity on the same topic. A within-subjects ANOVA was performed and the only comparison that showed a significant difference was the difference in persistence between the video sessions and the activity sessions (see Figure 4). That is, there was no overall difference between classrooms, between high or low SES classrooms, between boys and girls, between videos or specific activities, between second or third graders. But the difference in persistence between sessions that began with video and sessions that began with a non-mediated activity was highly significant ($F_{1,73} = 22.65$ and $p < .0001$).

More specifically, three between-subjects contrast-coded F tests were performed. Low vs. high SES classrooms were compared (7.95 minutes vs. 8.10 minutes) and were not significantly different ($F_{1,73} = .19$, $p = .66$). Among the low SES classrooms, the bilingual vs. single-language classrooms were compared (7.68 minutes vs. 8.22 minutes) and were not significantly different ($F_{1,73} = 1.14$, $p = .29$). Among the high SES classrooms, the second vs. third grade classrooms were compared (8.43 minutes vs. 7.77 minutes) and were not significantly different ($F_{1,73} = 1.07$, $p = .31$).

Three within-subjects contrast coded F tests were performed. As mentioned above, when the sessions that began with video were compared to the sessions that began with activity the number of minutes children persisted (7.53 vs. 8.50 minutes) differed significantly ($F_{1,73} = 22.65$, $p < .0001$)). When the scale model video session was compared to the mental math video session (7.56 vs. 7.49 minutes) there was no significant difference ($F_{1,73} = .51$, $p = .48$). Finally when the scale model activity was compared to the mental math activity (8.62 vs. 8.37 minutes), again there was no significant difference ($F_{1,73} = 1.76$, $p = .19$). There were no significant interactions.

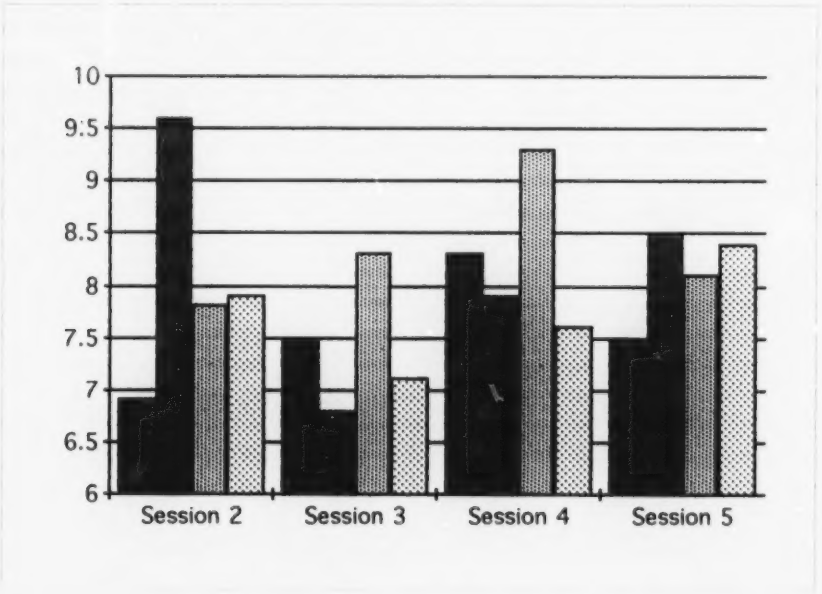
Another ANOVA was performed using gender, rather than classroom, as the between-subjects grouping. There was no difference between boys and girls on the persistence task (7.89 vs. 8.03 minutes) ($F_{1,75} = .117$, $p = .73$).



	Video: Scale	Video: Mental	Activity: Scale	Activity: Mental
Class 1	7.62	7.26	7.5	8.35
Class 2	7.8	6.89	9.47	8.71
Class 3	7.64	8.23	9.35	8.48
Class 4	7.12	7.59	8.41	7.94
Overall	7.56	7.49	8.62	8.37

Figure 4: Average Number of Minutes Persisted by Class

Even though the session types were counter-balanced to diminish any order effects, order effects are common in within-subjects designs. I performed a contrast-coded trend analysis based on session-order and found that each of the classrooms showed a different significant ($p<.05$) quadratic trend such that two classrooms curved downward in the middle and two classrooms curved upward in the middle. Since the classrooms had all four sessions in a different order these different trends were fairly well balanced (see Figure 5). There were no linear trends.



	Session 2	Session 3	Session 4	Session 5
Class 1	6.9	7.5	8.3	7.5
Class 2	9.6	6.8	7.9	8.5
Class 3	7.8	8.3	9.3	8.1
Class 4	7.9	7.1	7.6	8.4
Overall	7.9	7.5	8.3	8.1

Figure 5: Average Number of Minutes Persisted by Session Order

Next, I asked whether there were any differences in how the sessions were rated by the children. There was no difference on the fun-boring scale, nor on the hard-easy scale between the video sessions and the activity sessions (see Tables 1 and 2). However, the scale model video was rated significantly more fun than the mental math video ($p<.05$).

	Video 1: Scale Models	Video 2: Mental Math	Activity 1: Scale Models	Activity 2: Mental Math
Class 1	2.3	2.2	2.5	3.0
Class 2	3.3	3.5	3.1	2.2
Class 3	2.8	2.6	2.3	2.7
Class 4	2.2	3.6	2.4	2.9
Overall	2.6	2.9	2.5	2.7

Table 1: Fun-Boring Rating on a Scale of 1 to 7 (Very Fun is 1)

	Video 1: Scale Models	Video 2: Mental Math	Activity 1: Scale Models	Activity 2: Mental Math
Class 1	5.0	5.6	5.2	4.8
Class 2	5.1	4.5	4.1	5.5
Class 3	5.5	4.4	4.9	4.8
Class 4	5.4	4.8	5.2	4.9
Overall	5.2	4.9	4.9	5.0

Table 2: Hard-Easy Rating on a Scale of 1 to 7 (Very Hard is 1)

There were no main effects on the hard-easy scale. So then I asked whether the fun-boring rating was related to persistence. That is, if a student rates a session as fun is the student more or less likely to persist on the tangram puzzles? These data, however, showed no relationship between the fun-boring rating and persistence. Nor was there a relationship between the hard-easy rating and persistence.

Finally I looked to see whether there were any treatment effects for how many puzzles were solved (see Table 3). That is, I looked at achievement following the treatments.

	Video 1: Scale Models	Video 2: Mental Math	Activity 1: Scale Models	Activity 2: Mental Math
Class 1	.17	.13	.13	.04
Class 2	.33	.20	.40	.27
Class 3	.14	.29	.29	.33
Class 4	.18	.29	.41	.18
Overall	.19	.22	.29	.19

Table 3: Proportion of Difficult Puzzles Solved

There was an interaction ($F_{1,73} = 4.29$, $p < .05$) between the two video sessions and the low versus high SES classrooms such that more low SES than high SES solved the tangram puzzles following the scale model video, while more high SES than low SES solved the tangram puzzles following the mental math video. Overall the only difference between the classes was that the bilingual low SES classroom solved more puzzles than the single language low SES classroom. There were no other significant differences.

Discussion

In sum, television's effects on behavior are widely feared (Healy, 1990; Mander, 1978; Postman, 1985; Winn, 1977) and seldom identified experimentally (Anderson & Collins, 1988). Other television studies have missed some profound effects television viewing may be responsible for by making Clark's (Clark, 1983) mistake: they assume that any effect of television must be produced by a factor unique to television. Most television studies attempting to identify some factor of television programming that could account for a hypothesized effect on persistent behavior have produced mixed results (Anderson et al., 1977; Friedrich & Stein, 1973; Singer, Singer & Rapaczynski, 1984; Tower et al., 1979). It is important to notice that while no one factor of the television viewing experience is unique to television, television may nevertheless be producing

effects in the viewer by nature of the kind of learning experience it facilitates (Kozma, 1991). In fact, it seems quite important that this learning experience is not unique, but similar in many respects to the uncontrollable conditions necessary for producing learned helplessness (Fox & Oakes, 1984; Hearn, 1991; Oakes, Rosenblum & Fox, 1982).

In this study the type of experience was examined for effects on persistence, rather than limiting the study to identifying a single factor. I compared two medium-based, passive, and non-contingent learning experiences with two non-medium-based, interactive, and contingent learning experiences of the same duration and on the same two topics. I examined persistent behavior in solving a difficult tangram puzzle and perhaps because this test of persistence does not depend on literacy level nor on acquisition of specific math content the test was relatively insensitive to curriculum and age differences. I found no difference due to age, particular classroom, gender, or socio-economic status. I also found no difference between the two topics. I found no difference in persistence related to rated attitude either, perhaps because the attitude measurement was too crude, or perhaps because the attitudes measured, enjoyment and difficulty, were not critical to persistent behavior. But the level of persistence following the non-medium-based learning experiences was quite significantly higher ($p<.0001$) than the level of persistence following the medium-based learning experiences.

Many questions, of course, remain. Is this merely a difference in persistence between medium-based and non-medium-based learning environments or is this part of a full learned helplessness pattern? Are attributions and beliefs contributing to this phenomenon and if so in what way? If 15 minutes of viewing is sufficient to produce the effect, how about 5 minutes? Persistence is affected immediately following the medium-based learning experience, how about after a delay of 10 minutes or half an hour? Does this extend to the use of computers? If interaction is necessary, how much interaction? Television viewing is still one of the major learning experiences available to learners of all ages. Rather than conclude, as some have (Anderson & Collins, 1988; Clark, 1983) that there is no medium effect unique to television, television research must look instead at the type of learning experience that television facilitates. For this type of learning experience, medium-based, passive, non-contingent, and quite widespread, may have many profound effects on learning and behavior.

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